**Egg Drop Project** Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Problem:** How can an astronaut land safely?

NASA is looking to hire a team of designers to design a new landing device for astronauts returning from space. Your task is to design and build an inexpensive prototype that will protect an egg that is released from the top of the stairs outside. The egg will represent the passenger in the space vehicle and it must land safely, without any fractures. To present your design to NASA, you will have to write up your process, data, and concluding thoughts in a formal lab report.

While designing your apparatus, use your knowledge of Newton’s Laws of Motion to anticipate the landing and what will work best to reduce the force of the landing. You will be asked to explain how the laws are involved in this scenario in your final report.

Each team of designers will be made of 2-3 people. You will receive 20 NASA dollars to spend on supplies for your egg landing apparatus. To test your apparatus, one person will drop the egg, while another person records the time it takes to descend, and the other person will document the impact and safety of the egg.

**Guidelines for creating the apparatus:**

* The objective is to create the least expensive apparatus that can hold a large**, unaltered, raw** egg, while protecting it from damage after being dropped.
* The apparatus must be made by your team and supplies cannot be brought in from home. You may use any of the materials listed on the next page, **as long as you stay within the $20 budget**. No pre-made containers can be used.
* You may not alter the egg in any manner, including painting, gluing, or wrapping the egg.
* You will be provided with one raw egg for the experiment.

**Pre-Lab.**

All notes, observations, sketches, data and conclusions questions should be written on pages 66-67 of ISN.

1. On page 66 of ISN, write out Newton’s second law of motion.
2. Copy and fill in the blank: The more mass your apparatus has, the more \_\_\_\_\_\_\_\_\_\_\_\_\_\_ it will have.

**Design & Plan:**

1. **Sketch:** On page 66 of your ISN, create a design for your apparatus using the materials on the following page. You will not be able to purchase your materials until each member of your team has a sketch of the apparatus in their ISN.
2. **Plan Purchase:** You do not need to use each of the materials offered, but must stay within a $20 budget. The prices for materials are on the back of this sheet. Use this in deciding how many materials to buy. As with any engineering project, you must have your costs approved by your boss (your teacher) before making any purchases.

STOP

1. **Purchase materials and Build:** Collect materials and begin to assemble your apparatus. **You must make note of any changes to your apparatus design in your ISN**. To do this, DO NOT ERASE your original design. Instead, draw a new design. Be sure to use labels in your ISN to explain how your design was constructed

|  |  |
| --- | --- |
| **Material** | **Price** |
| Paper towel roll | $2.00 |
| Popsicle Stick | $1.00 |
| Rubber Band | $1.00 |
| Straw | $1.00 |
| Balloon | $3.00 |
| String/yarn | $1.00/ 30cm |
| Washer | $1 |
| Tape | $1.00/ 30 cm |
| Paper | $2/sheet |
| Rubber Band | $1.00 |
| Paper Clip | $1.00 |

**You must stay within budget!**

The egg is free! Compliments of your teacher!

Each egg will be placed into a sandwich bag prior to take-off to prevent the exposure of bodily fluids upon impact.

|  |  |  |  |
| --- | --- | --- | --- |
| **Material** | **Price** | **Quantity** | **Total Price** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

Total Price:

**Landing Grade Rubric**

You will receive a grade for the landing in addition to a grade for your final lab report. All members of each group will be given the same landing grade based on how well you stayed within the requirements listed.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **10** | **9** | **8** | **7** | **0** |
| Egg survives with no cracks/damage. Group is within budget and used allowed materials | Egg is cracked, but intact. Group is within budget and used allowed materials. | Egg has lost its innards. Group is within budget and used allowed materials. | Group goes over budget or uses supplies that are not on the list. | Group doesn’t participate or tried to “cheat” the system (alters egg). |

**Testing the Landing Apparatus**

**Roles:** 1 timer, 1 egg releaser, 1 recorder/observer per group.

**Materials:** scale, stopwatch, meter stick, ISNs, and egg landing apparatus.

Copy the data table below onto page 67 of ISN. Use it to record your data today.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Mass of egg and apparatus before drop (kg)**  (there are 1000 grams per kg) | **Distance apparatus is dropped**  (meters) | **Time to drop**  (in seconds) | **Observations of landing.**  Be as detailed as possible. | **Status of the egg after drop** |
|  |  |  |  |  |

1. Place the landing apparatus at the top of the wall and have one student hold it in place. At least one person should be at the bottom of the wall with a stop watch. Measure the distance that the egg will be dropped.
2. When the timer says go, the person at the top of the wall will let go of the apparatus and the timer will start the stop watch at the same time. The timer will stop the watch when the egg hits the ground and will record the time in the data section of ISN.
3. The recorder will inspect the egg to determine if it is safe. You may take a picture with your cell phone to be placed into your lab report or make a detailed sketch of any fractures in your ISN. Be as detailed as possible.
4. Share data with group members.

**Conclusion Questions for Lab Report:** Answer on pages 66-67.

1. What changes did you make to your landing apparatus from the time that you completed your first sketch to the moment you released it in the drop? Why?
2. How does the mass of the device affect the safety of the egg? Explain by referencing Newton’s Laws of Motion.
3. How much force did the landing apparatus have as it was falling? Show your calculations with your answer. The units of force will be in Newtons (N).

Force= mass x acceleration

The **acceleration** rate due to gravity is 9.8 m/s2.

1. How would an increase in mass of the landing device alter the impact of the egg on the ground?
2. What was the speed of the landing device as it fell from the top of the wall if the wall is \_\_\_\_\_\_\_\_\_\_\_\_\_ meters? Show your work and the speed. How would the speed affect the egg’s safety?

**Final Lab Report Rubric**

Each student must turn in **their own, typed** lab report. This is not a group effort. Follow the Science Lab Report Format that you were given in the first week of school (page 6 of ISN) to construct your lab report and refer to the grading rubric below.

Before handing in the final draft of your lab report, self asses your work on the rubric below.

**Student Teacher**

\_\_\_\_ \_\_\_\_/1 Student name and lab title given at the top of the page with no extra

white space.

\_\_\_\_ \_\_\_\_\_/1 All headings are bolded

**Introduction**

\_\_\_\_\_ \_\_\_\_\_\_/2 Problem and purpose were stated and explained.

\_\_\_\_\_ \_\_\_\_\_ /2 Explanation of how this problem relates to your life. Why

would you study it?

\_\_\_\_\_ \_\_\_\_\_ /3 Hypothesis explained. Why was the original design constructed? Why

did you think this would keep your egg safe?

**Materials**

\_\_\_\_\_ \_\_\_\_\_\_/5 All materials and quantities used to construct the egg device are given in

a list form.

**Method**

\_\_\_\_\_ \_\_\_\_\_\_ /8 Step-by-step instructions are given so that the egg-landing apparatus

could be replicated.

\_\_\_\_\_\_ \_\_\_\_\_\_/5 All sketches of the landing device are included in your report. Sketches

are clearly labeled and help the reader understand how to build the device.

**Data**

\_\_\_\_\_\_ \_\_\_\_\_\_ /5 Data table was completely filled out and units are included.

**Analysis**

\_\_\_\_\_\_ \_\_\_\_\_\_/5 Final sketch or photo of landed device is included and a detailed

description of final egg condition is given.

**Conclusion**

\_\_\_\_\_\_ \_\_\_\_\_\_/8 All conclusion questions (from above) are answered. The question is

either restated or the prompt is echoed so the reader knows what the

question was. Math is shown when required. Reflection shows a strong understanding of Newton’s Laws.

\_\_\_\_\_ \_\_\_\_\_\_/ 5 Conclusion questions from ISN Lab Report Format are answered

\_\_\_ Did the design work? Why or why not?

\_\_\_What did you learn from this experiment?

\_\_\_ What sources of error could have affected your experiment?

\_\_\_ What future changes could you make to make this landing device safer?

**FINAL GRADE: \_\_\_\_\_\_\_/50**

Extension: For extra credit, design a NEW apparatus and explain how it would be safer for the egg.